BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/061,218	02/04/2002	Masao Someya	42261	2110

1609 7590 12/08/2003

ROYLANCE, ABRAMS, BERDO & GOODMAN, L.L.P.
1300 19TH STREET, N.W.
SUITE 600
WASHINGTON,, DC 20036

EXAMINER	
LISH, PETER J	

ART UNIT	PAPER NUMBER
1754	

DATE MAILED: 12/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

CLO 11

Office Action Summary	Application No.	Applicant(s)	
	10/061,218	SOMEYA ET AL.	
	Examiner	Art Unit	
	Peter J Lish	1754	

-- Th MAILING DATE of this communication appears on the cover she t with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 September 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *14-22,25,26 and 29-35* is/are allowed.

6)☒ Claim(s) *1-13,23,24,27 and 28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Applicant's arguments, see paper #10, filed 9/24/03, have been fully considered and are persuasive. The rejection of the previous office action has been withdrawn. It is noted that the amendment of the claims to read "substrate prepared by the process which consists essentially of the steps..." is viewed to differentiate between the presently claimed invention and any prior art which includes an additional step, such as anodization or other processes for the formation of cavities, in the preparation of the substrate. However, upon further consideration, a new ground(s) of rejection is made in view of the amendment.

The amendment filed 9/24/03 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the amendment to page 6, lines 10-17.

Applicant is required to cancel the new matter in the reply to this Office Action.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 112

Claims 2 and 7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 2 and 7 recite the process step of "allowing a metallic element... to be loaded". A step of "allowing" is not a positive process step. Perhaps "loading a metallic element..." is meant.

Claim Rejections - 35 USC § 102

Claims 1-3, 6, 11, 13, and 27-28 are rejected under 35 U.S.C. 102(a) as being anticipated by ("Printing Gel-like Catalysts for the Directed Growth...").

Kind teaches a process for the growth of aligned carbon nanotubes from a substrate. The substrate is made of silicon and is coated with a silicon dioxide film, which has no catalytic ability. A patterned and inked stamp is used to print a catalyst as a pattern onto the film. The growth of multiwalled carbon nanotubes follows from the catalytic decomposition of acetylene on the printed pattern of the catalyst. Catalysts used are iron, nickel, and cobalt. The chemical vapor deposition was performed using acetylene gas at a temperature of about 720 °C. No difference is seen between the process of Kind et al. and that of the instantly claimed invention.

Claims 8-9 are rejected under 35 U.S.C. 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kind et al. as applied above.

Regarding claims 8-9, it is not explicitly taught that the catalyst salt solutions form catalyst particles with a size of between 1 and 20 nm. However, it is expected that this be the case because nanotubes of this diameter are formed by the process of Kind et al. (Figure 4) and it is known in the art that the diameter of carbon nanotubes grown from metallic catalysts correspond closely to the diameter of the catalyst particles.

Claim Rejections - 35 USC § 103

Claims 1-13, 23, and 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 6,514,113 B1) alone or in view of Lee et al. (6,350,488 B1).

Lee et al. ('113) teaches a process for the growth of aligned carbon nanotubes over a substrate material. The substrate is prepared by coating a metal film of aluminum, etc, which has no catalytic ability for the growth of carbon nanotubes, on a substrate of silicon, alumina, quartz, or glass. A catalytic metal film, such as that containing cobalt, nickel, or iron, is then formed on the coated substrate. Once the substrate is formed, the catalyst is grain-boundary etched to separate the catalytic metal film into fine isolated catalytic metal particles, which are then contacted with a carbon source in a chemical vapor deposition process to grow aligned carbon nanotubes.

According to claim 1 of the present invention, the process of forming the substrate is limited to the declared steps, however, the step of grain-boundary etching is not viewed to be part of the formation of the substrate. Further support for this view is evident in Lee '488 which discloses that the grain-boundary etching of the catalytic metal and the formation of the carbon nanotubes are in-situ performed in the same thermal CVD apparatus and further that the etching gas is supplied along with the carbon-containing gas. Therefore, the grain-boundary etching step is viewed to be part of the process for the formation of an aligned nanotube film.

Regarding claims 4, the metal layer having no catalytic ability is deposited to a thickness of about 0.3 to 0.5 microns. Regarding claim 7, the step of loading the metallic catalyst is performed by a method of forming a thin film. Official Notice is taken that impregnation, dipping, and sol-gel processes are known methods of forming thin films of catalytic material, and therefore it would have been obvious to one of ordinary skill at the time of invention to use any

of these known methods. Regarding claims 8-9, the catalytic metal particles are preferably formed to have a size of 20-60 nm. Regarding claim 23, Official Notice is taken that alumina is a porous material. Regarding claims 27-28, the chemical vapor deposition is carried out at a temperature of between 450 and 1000 °C in the presence of a hydrocarbon gas, such as acetylene, ethylene, propylene, or methane gas.

Claims 1-6, 8-13, 23, and 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 6,514,113 B1) taken with Ren et al. (US 2003/0203139 A1).

Lee et al. teaches a process for the use of carbon nanotubes in electron emission, comprising the growth of aligned carbon nanotubes over a substrate material. The substrate is prepared by coating a metal film of aluminum, etc, which has no catalytic ability for the growth of carbon nanotubes, on a substrate of silicon, alumina, quartz, or glass. A catalytic metal film, such as that containing cobalt, nickel, or iron, is then formed on the coated substrate. Aligned carbon nanotubes and then grown perpendicular to the substrate by a chemical vapor deposition process, which includes the grain-boundary etching of the catalyst film.

Ren et al. teach a process for the growth of aligned carbon nanotubes from a substrate wherein a substrate is coated with a catalyst metal film or catalyst metal nano-dots, such as that containing cobalt or nickel, to a thickness of about 15 nm. Carbon nanotube growth is then induced by plasma-enhanced chemical vapor deposition at a temperature of between 300 and 3000 °C in the presence of a carbon source gas and a catalyst gas. The carbon source gas may be any saturated or unsaturated, linear or cyclic carbon-containing gaseous compound, whereas the catalyst gas may be either ammonia or nitrogen. Vertical growth is controlled by the angle

placement of the substrate in the CVD chamber with respect to the orientation of the electric field of the plasma generator. Ren teaches that the process for the formation of aligned nanotubes may be used for electron emission.

It would have been obvious to one of ordinary skill at the time of invention to use the process of growing aligned carbon nanotubes using plasma-enhanced CVD, as taught by Ren et al., on the substrate material of Lee et al., because it will perform the required growth of carbon nanotubes aligned normal to the substrate, which may be used for electron emission.

Regarding claims 4, the metal layer having no catalytic ability is deposited to a thickness of about 0.3 to 0.5 microns. Regarding claims 8-9, it is expected that the catalytic metallic elements may be produced to comprise particles with a size of about 20 to 50 nm, because nanotubes of this diameter are formed by the process of Ren et al. (paragraph 0095), and it is known in the art that the diameter of carbon nanotubes grown from metallic catalysts correspond closely to the diameter of the catalyst particles. Regarding claim 23, Official Notice is taken that alumina is a porous material.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. ('113) alone or in view of Lee et al. ('488) or over Lee et al. ('113) taken with Ren et al. as applied above, and further in view of Hafner et al. (US 2002/0112814 A1).

Lee et al. teach a process for the production of vertically aligned carbon nanotube films on substrates. Lee et al. teaches that the step of loading the metallic catalyst is performed by a method of forming a thin film, such as sputtering. Hafner et al. also teach a process for the production of vertically aligned carbon nanotube films on substrates, wherein the step of loading

the metallic catalyst is performed by a method of forming a thin film, such as evaporation, dipping, or electrodeposition. Hafner specifically teaches, as a means for forming a catalyst thin film, the dipping of the substrate into a solution comprising a metallic salt and an alcohol. It would have been obvious to one of ordinary skill at the time of invention to use the dipping process of Hafner et al. as the means for forming a thin film of metallic catalyst in the process of Lee et al., because it is an equivalent and known method of forming a catalyst thin film.

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. ('113) alone or in view of Lee et al. ('488) or over Lee et al. ('113) taken with Ren et al. as applied above, and further in view of Ohki et al (US 6,545,396 B1).

Lee et al. teach a process for the production of aligned carbon nanotube films for an electron emission device. Lee et al. teach the use of a variety of substrates, including silicon, alumina, and other ceramic materials. Lee et al. do not explicitly teach the use of a silica-alumina substrate. Ohki et al. teach a similar process for the production of aligned carbon nanotube films for electron emission devices. Ohki et al. teach the preferred use of a silica-alumina substrate as it has the ability to withstand damage from the high temperatures needed for nanotube growth. It would have been obvious to one of ordinary skill at the time of invention to use the silica-alumina substrate of Ohki et al. as the substrate of Lee et al. because it is a ceramic material with high heat endurance capability.

Allowable Subject Matter

Claims 14-22, 25-26, and 29-35 are allowed.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Terrones et al. ('Controlled production of aligned-nanotube bundles') and Li et al. ('Large-Scale Synthesis of Aligned Carbon Nanotubes').

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter J Lish whose telephone number is 703-308-1772 until December 11th and 571-272-1354 thereafter. The examiner can normally be reached on 9:00-6:00 Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached at 703-308-3837 until December 11th and 571-272-

1358 thereafter. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

PL

STUART L. HENDRICKSON
PRIMARY EXAMINER